Lecture 2

Cell Biology II

By

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Prokaryotic Cells

Prokaryotic cells are the most primitive cells and have simple structural organization.It has a single membrane system. They include bacteria, viruses, blue-green algae,

mycoplasmas, rickettsias, spirochetes etc. Cyanobacteria or blue green algae are the largest and most complex prokaryote, in which photosynthesis of higher plants type

have evolved. Prokaryotes are included in the kingdom Monera and the super kingdom Prokaryota. The Prokaryotes have the following characters:

1. The size of prokaryotic cells ranges between 1 to 10 µm. They occur in a variety of forms.

2. Prokaryotic cell consists of three main components:

(I) **Outer covering:** It is composed of inner cell or plasma membrane, middle cell

wall and outer slimy capsule.

a.Cell membrane: Cell membrane made up of lipids and proteins, is thin and flexible and controls the movement of molecules across the cell. Respiratory enzymes are carried by it for energy releasing reactions.

b. **Cell wall :** It is a rigid or semi-rigid non-living structure that surrounds the cell membrane and its thickness ranges between 1.5 to 100 µm. Chemically it is composed of **peptidoglycans**. . Some bacteria such as mycoplasmas lack cell wall.

c. **Slimy capsule:** A gelatinous coat outside the cell wall is the slimy capsule. It is composed of largely of polysaccharides and sometimes it may have polypeptides and other compounds also. It protects the cell against desiccation, virus attacks,phagocytosis and antibiotics.

(II) Cytoplasm: Prokaryotic cytoplasm contains proteins, lipids, glycogen and inorganic ions along with enzymes for biosynthetic reactions and ribosomes, tRNA and mRNA for protein synthesis.

(III) Nucleoid: Nuclear envelope is absent in prokaryotic cell and the genetic material lies directly into the cytoplasm. Such nuclear material is known as nucleoid. Nucleoid consists of greatly coiled single pro-chromosome.

Eukaryotic Cells

The internal organization of eukaryotic cell is more developed than prokaryotic cells from which they are believed to have been evolved. They are evolved to have double membrane system. Primary membranes are the one that surrounds the cell, celled cell or plasma membrane and the secondary membrane surround the nucleus and other cellular organelles. Eukaryotic cells occur in protists, fungi, plants and animals. Eukaryotic cells occur in protists, fungi, plants and animals.Eukaryotic cells have the following characteristics:

1. Number-

In multicellular organisms the numbers of cells are correlated with the body size. The human blood contains about 30 quadrillion (3 × 1015) corpuscles and a 60 kg human being has about 60 × 1015 cells. All multicellular organisms begin their life with a single cell “Zygote” and then become multicellular by its mitotic division during development.

2. Shape-

A cell may be spherical, cuboidal, oval, disc-like, polygonal, columnar, spindle like or irregular. Thus, cells acquire a variety of shapes not only in various organisms but also in different tissues of the same organism. The shape of cell is correlated with its functions like the shape of muscles and nerve cells are well adapted to their functions. Many factors such as cell functions, age of cell, presence or absence of cell wall, viscosity of cytoplasm etc. are responsible for various shapes of cells.

3. Size-

Most of the eukaryotic cells is microscopic and their size ranges between 10 to 100µm. Sporozoits of malaria parasite (Plasmodium vivax) is among the smallest cells having the size equal to 2µm long. While the Ostrich egg measures 175 × 120mm. Nerve cells are the longest having the size of its fiber to be of few meters long. Human cells generally range from 20 to 30µm.

4. Components of a cell-

Three main components of the eukaryotic cells are cell membrane, cytoplasm and nucleus. The cytoplasm and the nucleus further have several components. Various cell components are discussed below:

(i) **Cell membrane-** Cell membrane, plasma membrane or plasmalemma is a thin elastic living covering that surrounds the cell keeping the cell contents in place,provides shape to the cell and controls the transfer of materials across it. It is composed of lipid-protein complex.

(ii) **Cytoplasm-** The cytoplasm or the cytosome is a semi-fluid, homogeneous, translucent ground substance known as cytoplasmic matrix or cytosol which is present between the cell membrane and the nucleus. In the protozoan cell the outer firm layer

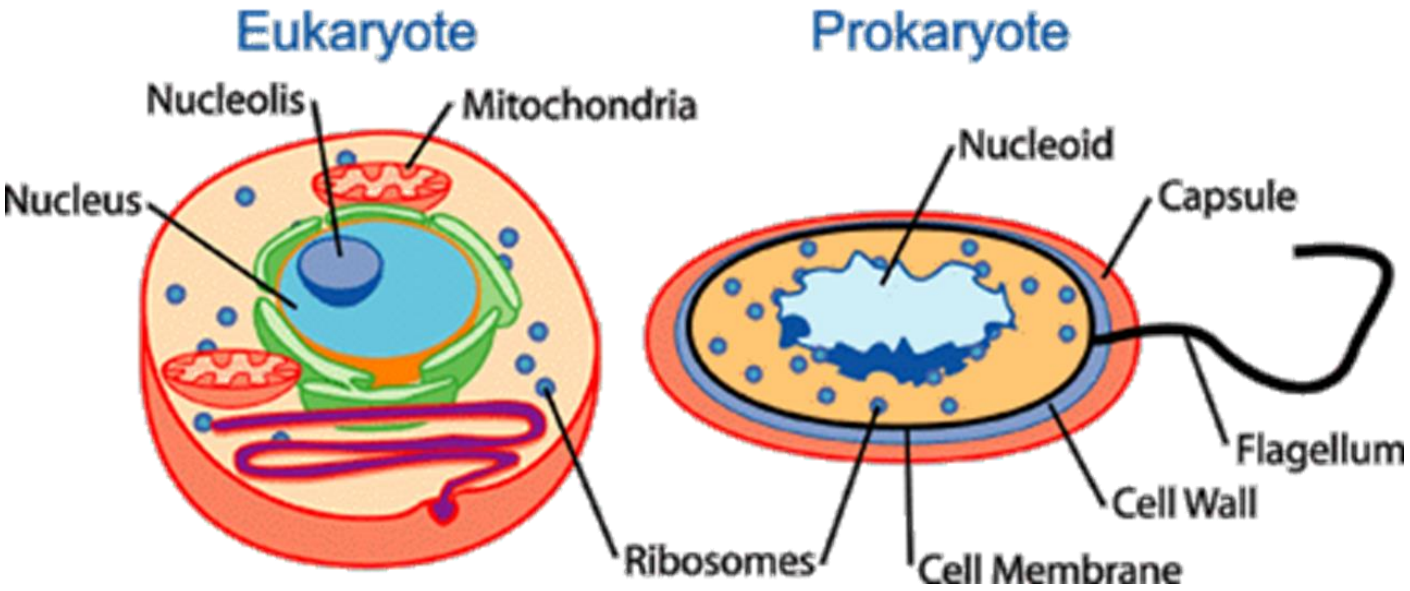
of cytoplasm is called ectoplasm and the inner layer around the central fluid mass is called the endoplasm. The cytosol shows “cyclosis” or the streaming movement. The eukaryotic cytoplasm has the following features:-

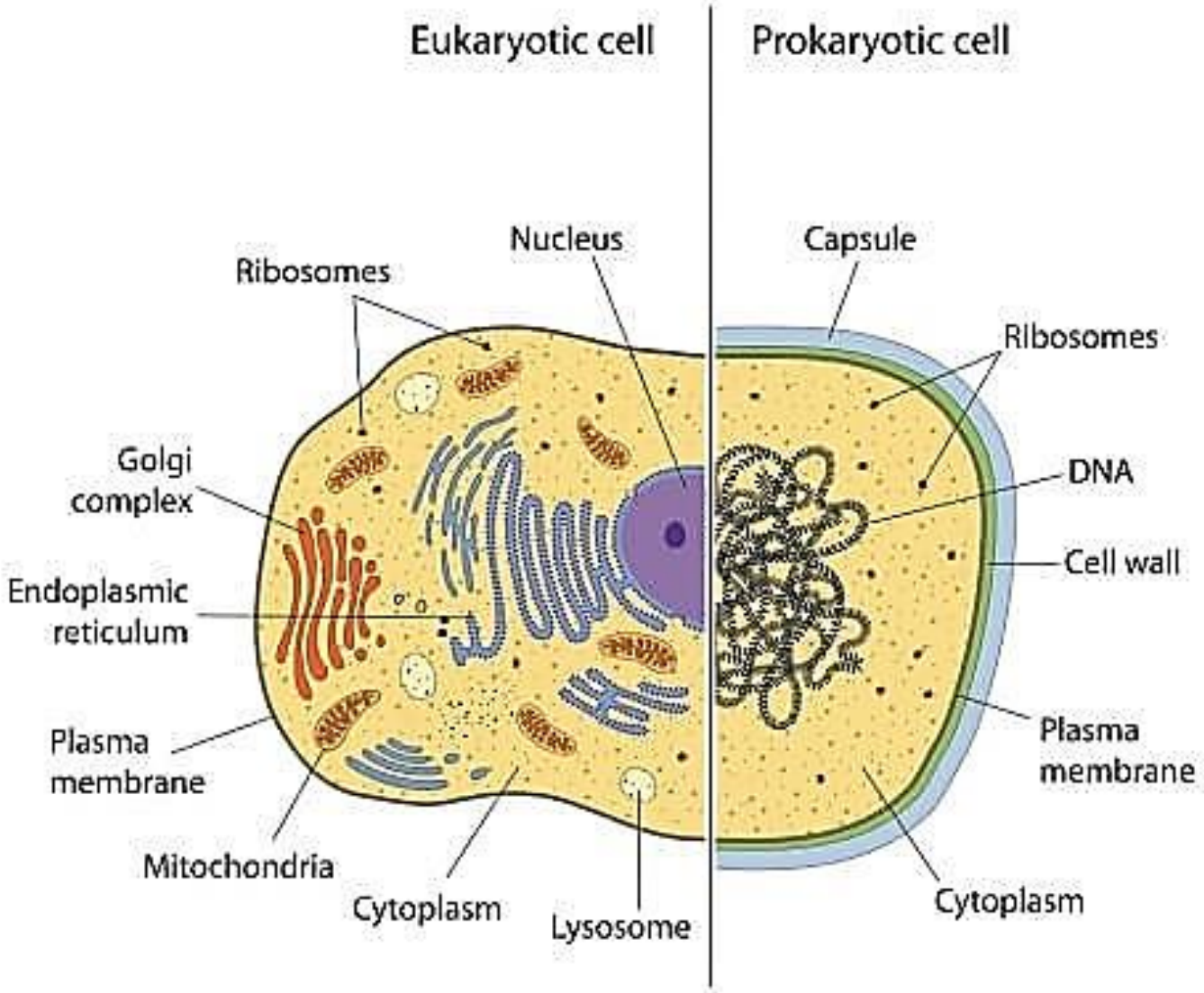
a.Organelles: The organized structures having the specific functions and capacity of growth and multiplication in some cases are known as organelles. Mitochondria, centrosomes, Golgi bodies, plastids and vacuoles are the organelles that can be observed under light microscope, while endoplasmic reticulum, ribosome, microfilaments, microtubules, intermediate filaments and micro bodies can only be seen under electron microscope

b. Inclusions: These are the non-living or deutoplasmic structures which are incapable of growth and multiplication. Common cell inclusions are stored organic materials such as starch grains, glycogen granules, aleuron grains, fat droplets, pigment granules and inorganic crystals.Cytoplasm is stores raw materials needed for the metabolism in both the cytoplasm and the nucleus.

c. Nucleus: In a eukaryotic cell the genetic material is enclosed by a distinct nuclear envelope that forms a prominent spherical organelle the “Nucleus”. The nuclear envelope bears pores for the exchange of materials between the cytoplasm

and the nucleoplasm.




Eukaryotic cell
Prokaryotic cell
Nucleus
Ribosomes
Golgi complex
Endoplasmic reticulum
Plasma membrane
Mitochondria
Cytoplasm
Lysosome
Capsule
Ribosomes
DNA
Cell wall
Plasma membrane
Cytoplasm

Cell Envelope and its Modifications

Most prokaryotic cells, particularly the bacterial cells, have a chemically complex cell envelope. The cell envelope consists of a tightly bound three layered structure i.e., the outermost glycocalyx followed by the cell wall and then the plasma membrane. Although each layer of the envelope performs distinct function, they act together as a single protective unit. Bacteria can be classified into two groups on the basis of the differences in the cell envelopes and the manner in which they respond to the staining procedure developed by Gram viz., those that take up the gram stain are **Gram positive** and the others that do not are called Gram **negative bacteria**

Glycocalyx differs in composition and thickness among different bacteria. It could be a loose sheath called the **slime layer** in some, while in others it may be thick and tough, called the **capsule**.

The cell wall determines the shape of the cell and provides a strong structural support to prevent the bacterium from bursting or collapsing. The plasma membrane is selectively permeable in nature and interacts with the outside world. This membrane is similar structurally to that of the eukaryotes.